



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/699,144	10/31/2003	Dhruva Ranjan Chakrabarti	200313003-1	3438
22879 7590 01/11/2008 HEWLETT PACKARD COMPANY P O BOX 272400, 3404 E. HARMONY ROAD INTELLECTUAL PROPERTY ADMINISTRATION FORT COLLINS, CO 80527-2400			EXAMINER WU, JUNCHUN	
			ART UNIT 2191	PAPER NUMBER
			NOTIFICATION DATE 01/11/2008	DELIVERY MODE ELECTRONIC

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

JERRY.SHORMA@HP.COM  
mkraft@hp.com  
ipa.mail@hp.com

## Office Action Summary

Application No.

10/699,144

Applicant(s)

CHAKRABARTI ET AL.

Examiner

Junchun Wu

Art Unit

2191

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 09 October 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1,3-8 and 10-21 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,3-8,10-15 and 16-21 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                       | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

**DETAILED ACTION**

1. This office action is in response to the amendment filed on Oct. 9, 2007.
2. Claims 1 and 15 are amended
3. Claims 2 and 9 are cancelled.
4. Claims 16-21 are new.
5. Claims 1, 3-8, 10-15 are pending in this application.

***Claim Rejections - 35 USC § 112***

6. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

7. Claims 16 and 17 rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.
8. Claim 16 recites "light-weight". There is no description of what the light weight is in the specification.
9. Claim 17 recites "inliner summaries are comprised of: a call savings, an optimization and a normalized level". There are no descriptions of those items in the specification.

*Claim Rejections - 35 USC § 103*

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

11. Claims 1, 4, 5, 7, 8, 11, 12, and 14-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over by Ayers et al. ("Aggressive Inlining", 1997, ACM, hereafter "Ayers") and in view of Schmidt (US Patent No. 6,195,793 B1).

12. Per claim 1 (Currently amended)

Ayers discloses

- A method of compiling a computer program, the method composing:
- receiving a plurality of modules of source code (Fig.1).
- generating intermediate representations corresponding to the modules (Sec.2.1 1<sup>st</sup> Para. Lines 1-6).
- extracting a set of data from the intermediate representations to create an inliner summary for each module (sec.2.2 1<sup>st</sup> Para. Lines 1-4 & 3<sup>rd</sup> Para. Lines 1-5).
- after a call site is determined to be inlined: updating a call graph of the routines and call sites, and updating the inliner summaries throughout the call graph (Sec.2.3 The Last Para.).

But Ayers dose not discloses

- using the inliner summaries and a globally-sorted working-list based order in an inline analysis phase, without using the intermediate representations in the inline analysis

phase, to determine which call sites in the modules are to be inlined by substituting code from a called module, wherein said globally-sorted working-list based order is dynamically updated during the inline analysis phase.

However, Schmidt implicitly discloses

- using the inliner summaries and a globally-sorted working-list based order in an inline analysis phase, without using the intermediate representations in the inline analysis phase, to determine which call sites in the modules are to be inlined by substituting code from a called module, wherein said globally-sorted working-list based order is dynamically updated during the inline analysis phase (col.3 lines 42~44 & lines 53-62).
- Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Ayer's teachings by adding using the inliner summaries and a globally-sorted working-list based order in an inline analysis phase, without using the intermediate representations in the inline analysis phase, to determine which call sites in the modules are to be inlined by substituting code from a called module, wherein said globally-sorted working-list based order is dynamically updated during the inline analysis phase as taught by Schmidt in order to select good inlining candidates by an adaptive approach in accordance with features of preferred embodiment (col.3 lines 40-42).

13. Per claims 4 and 11 (Previously presented)

the rejection of claim 3 and 10 are incorporated respectively and Ayers discloses

- updating the inliner summaries comprises determining nodes and edges of the call graph that are affected by the inlining of the call site and updating those inliner summaries corresponding to the affected nodes and edges (Sec.2.3 The Last Para. Lines 5-8).

14. Per claims 5 and 12 (Previously presented)

the rejection of claim 4 and 11 are incorporated respectively and Ayers discloses

- the edge summaries include at least a call site execution count and a signature type (Sec.2.3 1<sup>st</sup> Para.).

15. (Original) Per claims 7

the rejection of claim 1 is incorporated and Ayers further discloses

- the inline analysis phase is separate and distinct from an inline transformation phase (Sec. 2.3 1<sup>st</sup> & 2<sup>nd</sup> Para. (i.e. analysis phase for determining which call site is clonable); Sec.2.3 6<sup>th</sup> & 7<sup>th</sup> Para. (i.e. transformation phase for using the results of analysis phase to create clones and fix call sites).

16. Per claim 8 (Currently amended)

Ayers discloses

- An apparatus for compiling a computer program, the apparatus comprising:  
A processor configured to execute computer-readable code; a memory system configured to store data; computer-readable code for a front-end portion of compiler program, the front-end portion of the compiler program being configured to receive a plurality of

modules of source code (Fig. 1), generate intermediate representations corresponding to the modules (Sec.2.1 1<sup>st</sup> Para. Lines 1-6), and extract a set of data from the intermediate representations to generate inliner summaries for the modules (sec.2.2 1<sup>st</sup> Para. Lines 1-4 & 3<sup>rd</sup> Para. Lines 1-5).

- after a call site is determined to be inlined: updating a call graph of the routines and call sites, and updating the inliner summaries throughout the call graph (Sec.2.3 The Last Para.).

Schmidt discloses

- Computer-readable code for a cross-module optimizer of the compiler program, the cross-module optimizer being configured to use the inliner summaries and a dynamically-updated globally-sorted working-list based order to analyze the call sites in an inline analysis phase, without using the intermediate representation, so as to determine which call sites in the modules are to be inlined by substituting code from a called module (col.3 lines 42~44 & lines 53-62).

17. Per claim 14 (Previously presented)

the rejection of claim 8 is incorporated and Ayers further discloses

- the inline analysis phase is separate and distinct from an inline transformation phase (Sec. 2.3 1<sup>st</sup> & 2<sup>nd</sup> Para. (i.e. analysis phase for determining which call site is clonable); Sec.2.3 6<sup>th</sup> & 7<sup>th</sup> Para. (i.e. transformation phase for using the results of analysis phase to create clones and fix call sites).

18. Per claim 15 (Currently amended)

Ayers discloses

- after a call site is determined to be inlined: updating a call graph of the routines and call sites, and updating the inliner summaries throughout the call graph (Sec.2.3 The Last Para.).

Schmidt discloses

- a computer program product comprising a computer-usable medium having computer-readable code embodied therein, the computer program product being compiled from a plurality of modules of source code using inliner summaries and a dynamically updated globally-sorted working-list based order in an inline analysis phase, without using intermediate representations, to determine which call sites in the modules are to be inlined by substituting code from a called module (col.3 lines 42~44 & lines 53-62).

19. Per claim 16 (New)

Schmidt discloses

A method of compiling a computer program with a plurality of modules of source code and corresponding intermediate representations (see Fig.1), the method comprising:

- using the inliner summaries in a one-pass inline analysis phase, without using the intermediate representations, to determine which call sites to inline, in what order to inline them, and preserving a same order during the transformation phase (col.2 lines 30~36 "*A first approximation of initial call sites of the identified possible call sites are identified for inlining. Procedures in the call multigraph are processed in a determined*



*order where a first procedure is only processed after all second procedures called by the first procedure are processed.”).*

- formulating a measure of goodness for each call site from the light-weight inliner summary (col.3 lines 40-44).
- using a technique to dynamically update information in the light-weight summary for potentially all call-graph nodes and edges every time a call site is accepted for inlining (col.3 lines 45-50).
- using a globally sorted work-list and an associated table to maintain and manipulate the call sites and dynamically updating the work-list every time a call site is accepted for inlining (col.3 lines 52-62).

Ayers discloses

- extracting a set of data from the intermediate representations of the modules to create a light-weight inliner summary for each module (sec.2.2 1<sup>st</sup> Para. Lines 1-4 & 3<sup>rd</sup> Para. Lines 1-5).

20. Per claim 17 (New)

the rejection of claim 16 is incorporated and Schmidt further discloses

- wherein the inliner summaries are comprised of: a code size (col.6 lines 3~4); a call site profile count (col.5 lines 30-33); a critical path length; an execution time (col.3 lines 44-46); a node level; a call savings; an optimization savings; a level criticality; a normalized level; and a total execution count (col.4 lines 30~32).

21. Per claim 18 (New)

- the rejection of claim 16 is incorporated and Schmidt further discloses wherein an arbitrary inlining order among the call sites in the call graph is selectable in an inline analysis phase, and wherein that same order is followed in an inline transformation phase (col.4 lines 2-6 “*the fundamental concept of the inline candidate selection method is to select an initial set of inline candidates and adaptively modify the initial set of inline candidates as more information becomes available.*”).

22. Per claim 19 (New)

- the rejection of claim 16 is incorporated and Schmidt further discloses wherein a measure of goodness for each call site is computed from the light-weight inliner summary, and a total profit is computed as a product of component profit factors, and a total cost is computed as a product of component cost factors (col.5 lines 21-25 “*The amount of code bloat that appropriately can incur is calculated by adding the total estimated instruction stream sizes for all procedures and multiplying by a tunable percentage factor, bloat factor as indicated at a block 202.*”).

23. Per claim 20 (New)

- the rejection of claim 16 is incorporated and Schmidt further discloses wherein information in the light-weight inliner summary corresponding to call-graph nodes and edges are updated each time a call site is accepted for inlining, and wherein a

goodness factor of each call site with updated summary information is re-computed (col.7 lines 31-33).

24. Per claim 21 (New)

- the rejection of claim 16 is incorporated and Schmidt further discloses wherein a globally-sorted work list and an associated table are maintained and used to continuously order the work list and extract a call site with a highest goodness factor (col.6 lines 8-13)

25. Claims 3, 6, 10, and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over by Ayers and in view of Schmidt (US Patent No. 6,195,793 B1).

26. Per claims 3 and 10 (Previously presented)

the rejection of claim 1 and 8 are incorporated respectively

Ayers does not teach

- after the call graph and inliner summaries are updated, re-calculating profitabilities associated with remaining call sites; and re-ordering the working list using the re-calculated profitabilities.

But Schmidt teaches

- re-calculating profitabilities associated with remaining call sites; and re-ordering the working list using the re-calculated profitabilities (Schmidt, col.7 lines 31-65).

- Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Ayer's teachings by adding re-calculating profitabilities associated with remaining call sites; and re-ordering the working list using the re-calculated profitabilities as taught by Schmidt in order to determine whether the alternate call site from working list (i.e. AuxQueue) should be inlined if the priority best call site in AuxQueue is less than a threshold that is acceptable for the original call site after the re-calculating (Schmidt, col.7 lines 39-51).

27. Per claims 6 and 13 (Previously presented)

the rejection of claim 4 and 11 are incorporated respectively

Ayers does not teach

- the node summaries include at least a code size, a routine execution count, and a call-graph height.

But Schmidt teaches

- the node summaries include at least a code size, a routine execution count, and a call-graph height (Schmidt, col.4 lines 26-34).
- Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Ayer's teachings by adding the node summaries include at least a code size, a routine execution count, and a call-graph height as taught by Schmidt in order to select good inlining and making accurate estimates of code bloat (Schmidt, col.3 lines 42-50).

***Response to Arguments***

Applicant's arguments filed on Oct. 9, 2007 have been fully considered but they are not persuasive.

In the remarks, Applicant argues that:

- (a) In regard to independent claims 1, 8 and 15 applicant respectfully submits currently amended claims that cited prior art does not disclose or suggest.
- (b) In regard to dependent claims 3, 6, 10 and 13 applicant respectfully submits currently that cited prior art combination does not disclose or suggest.

**Examiner's response:**

Examiner disagrees.

- (a) Applicant's arguments with respect to claims 1, 8 and 15 have been considered but examiner cited the different paragraphs of prior art for the currently amended claims. Please see details of this office action.
- (b) Since currently amended independent claims have been cited prior art in different paragraphs, claim rejections under 35 USC 103(a) will be maintained.

*Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Junchun Wu whose telephone number is 571-270-1250. The examiner can normally be reached on 8:00-17:00 M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wei Zhen can be reached on 571-272-3708. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JW



WEI ZHEN  
SUPERVISORY PATENT